

2005 RESEARCH PERMITS

Charles Schelz / SEUG Ecologist

ARCHES NATIONAL PARK

2005 Research Permits

1) Permit #: ARCH-2005-SCI-0001

Study Title:

THE MOAB SITE ENVIRONMENTAL AIR MONITORING PROGRAM - CONDUCTED BY THE U.S. DEPARTMENT OF ENERGY'S OFFICE OF ENVIRONMENTAL MANAGEMENT LOCATED IN GRAND JUNCTION, COLORADO.

Primary investigator contact information:

Name: Mr. Joel Berwick, U.S. Department of Energy (DOE)

Address: 2597 B3/4 Road, Grand Junction, CO 81503

Phone: 970.248.6020

Email: joel.berwick@gjo.doe.gov

Project Summary:

DOE's environmental air monitoring program will monitor local and background air quality for various radio-particulates (U-nat, Th-230, and Ra-226), radon-222, and opacity (i.e., fugitive dust emissions).

2004 Findings and Status:

Monitoring data collected during 2004 indicate that concentrations of airborne radioparticulates (i.e., Po-210, Ra-226, Th-230, and natural [total] Uranium), atmospheric radon-222, and direct gamma radiation levels observed at the Arches National Park monitoring location are indistinguishable from background (naturally occurring) concentrations and levels. None of the 2004 data collected at this location exceeded any regulatory limit, threshold, or guideline that is applicable to this study. The uranium mill tailings stockpiled at the former Atlas mill site (located approximately 0.75 miles south of the Arches National Park entrance) do not appear to have any significant impact upon air quality and public radiation dose/exposure levels, as measured at the entrance to Arches National Park. DOE is required to conduct environmental monitoring and surveillance at sites where DOE activities have the potential to release contaminants to either the public and/or the environment. DOE will continue to monitor air quality and public exposure limits at this location to document negative exposure and public impacts, and to better understand variations in seasonal air quality conditions.

2005 Findings and Status:

Monitoring data collected during 2005 indicate that concentrations of airborne radioparticulates (i.e., PO-210, Ra-226, Th-230, and natural [total] Uranium), atmospheric radon-222, and direct gamma radiation levels observed at the Arches National Park monitoring location are indistinguishable from naturally occurring concentrations and levels. None of the 2005 data collected at this location exceeded any regulatory limits, thresholds, or guidelines that are applicable to this study. According to the measurements taken during this reporting period at the monitoring station near the park entrance, the uranium mill tailing stockpile at Moab UMTRA Project site (located approximately 1/2 mile south of the Arches National Park entrance) does not appear to have any significant impact on the air quality or public radiation dose and exposure levels. DOE is required to conduct environmental monitoring at sites where its activities have the potential to release contaminants to the public and/or to the environment. DOE will continue to monitor the air quality and public

exposure limits at this location for the duration of the Moab UMTRA Project to document any exposure impacts and to better understand variations in seasonal air quality conditions.

2) Permit #: ARCH-2005-SCI-0002

Study Title:
BCS PROJECT / BARRIER CANYON STYLE ROCK ART DOCUMENTATION.

Primary investigator contact information:

Name: Mr. David Sucec, BCS PROJECT
Address: 832 Sego Avenue, Salt Lake City, UT 84102
Email: davids@networld.com **Phone:** 801-359-6904
Fax: n/a

Project Summary:

The objectives of the BCS PROJECT documentation project are to record all Barrier Canyon Style rock art images with archival photographic prints (gelatin-silver and ultra-stable color prints), to create a complete inventory of the documented sites, and to generate a scholarly description and analysis of the imagery.

2005 Results and Status

No work was performed in ARCH in 2005

3) Permit #: ARCH-2005-SCI-0003

Study Title:
THE FORMATION OF CONJUGATE DEFORMATION BANDS AT THE GARDEN AREA

Primary investigator contact information:

Name: Ms. Kimberly Artita, University of Nevada, Reno
Email: kimby@mines.unr.edu **Phone:** 775.250.1550
Address: 1101 Keystone Ave #6, Reno, NV 89503

Project Summary:

A special type of strike-slip fault forms in the porous Entrada Sandstone at the Garden Area. The purpose of this study is to: 1) re-evaluate the map constructed by Zhao and Johnson, 2) take samples for thin sections (to determine what type of deformation bands they are), 3) assess the relative stress magnitudes and orientation at the time of deformation, 4) determine the dilatancy angle of the Entrada Sandstone, and 5) re-evaluate the interpretations of Zhao and Johnson.

4) Permit #: ARCH-2005-SCI-0004

Study Title:
RECORDING BARRIER CANYON STYLE ROCK ART

Primary investigator contact information:

Name: Mr. Michael Firnhaber, University of Colorado, Boulder

Address: Post Box 2046, Estes Park, CO 80517
Phone: 970.586.2695 or 970.586.2695 **Email:** m.firnhaber@ucl.ac.uk

Project Summary:

The purpose of the proposed study is to record, for the purpose of analysis and interpretation, the Barrier Canyon Style rock art tradition.

2005 Findings and Status:

No activity was conducted this report year.

5) Permit #: ARCH-2005-SCI-0005

Study Title:

VISITOR IMPACT STUDY WITH THE USE OF AERIAL PHOTOGRAPHY

Primary investigator contact information:

Name: Craig Randall

Address: 2618 S 200 W #4, Bountiful, UT 84010

Phone: 801.294.9099

Email: ktotam@comcast.net

Project Summary:

This study will test a non-intrusive program for monitoring visitor impact in the parks. It may provide an effective way to monitor visitor impact on soil conditions, vegetation, and social trails. This data will be acquired through the use aerial photos obtained by cost effective UAV's. (Unmanned Aerial Vehicles) These quiet, electric remote controlled aircraft will obtain the necessary photo's in a non-intrusive way, using established roads or trails to fly from. The UAV's are light, small and easily portable in a small vehicle from one photo location to another.

These UAV's will give the ecologist a bird's eye view of the areas most prone to impact from visitors. Over a repeat period of time these aerial photos may be able to show visitor effects on the parks resources.

2005 Findings and Status:

Photos were taken throughout Arches NP but no analysis has been performed. This is a good baseline set for future trend analysis.

6) Permit #: ARCH-2005-SCI-0006

Study Title:

**HERBARIUM AND FIELD STUDIES OF VASCULAR PLANT FLORA OF ARCHES NP FOR
NATIONAL PARK SERVICE INVENTORY AND MONITORING PROGRAM**

Primary investigator contact information:

Name: Walter Fertig

Address: 1117 West Grand Canyon Dr., Kanab, UT 84741

Phone: 435-644-8129

Email: walt@kanab.net

Project Summary:

The purpose of this study is to document the vascular plant flora of Arches National Park (ARCH) and develop a plant distribution database using the National Park Service's NPSpecies system.

2005 Findings and Status:

As a first step in developing an updated species list and distribution database for the park, I examined all specimens in the Arches NP herbarium to correct misidentifications, update species nomenclature (following Welsh et al. 2003, "A Utah Flora, third edition"), and add variety or subspecies names if needed. Of the 623 specimens currently deposited in the collection, 32 were misidentified (5.1%), 28 had their names updated (4.5%), 122 had variety names added (19.6%), and 441 were confirmed as correctly identified (70.8%). Another 259 specimens reported in the park's museum database (ANCS+) are presently on loan and could not be verified. The Arches herbarium currently contains 365 vascular plant taxa collected within the park (plus an additional 14 species from outside park boundaries). At least 122 additional plant species have been reported for Arches NP by Schelz and Moran (2005 SE Utah Group Plant list) and Harrison et al. (1964 "Plants of Arches National Monument, BYU Biological Series 5(1):1-23) but are not represented by collections in the Arches herbarium. Based on the Atlas of the Utah Flora (Albee et al. 1988), 229 additional species are reported from comparable habitats in the vicinity of Arches NP, but have not yet been documented within the park. These results suggest that the Arches NP herbarium is missing a significant number of plant taxa known or likely to occur in the park. In particular, fall-flowering and wetland species appear to be under-represented. Targeted inventory work to fill gaps in the Arches NP vascular plant collection is recommended so that park manager's will have an improved understanding of the composition and status of the flora of the park and a more complete reference collection for researchers and staff interested in plant identification.

7) Permit #: ARCH-2005-SCI-0007**Study Title:**

AMPHIBIAN RESEARCH AND MONITORING INITIATIVE (ARMI): PACIFIC NORTHWEST AND ADJACENT ARIDLANDS—ARCHES NATIONAL PARK INDEX SITE

Primary investigator contact information:

Name: Tim Graham, USGS

Address: 2290 West Resource Blvd, Moab, UT 84532

Phone: 435 719-2339

Email: tim_graham@usgs.gov

Project Summary:

To develop effective monitoring protocols that will provide the proportion of habitat units that host breeding populations of amphibians within selected survey areas, in a design that allows broad inference to all of Arches National Park. Integrate findings in Arches National Park with a national amphibian monitoring program.

2005 Findings and Status:

No activity was conducted in Arches NP in 2005 related to this project.

8) Permit #: ARCH-2005-SCI-0008**Study Title:**

IMPACT OF INTRODUCED GRASSES ON GRASSHOPPER COMMUNITIES IN COLORADO PLATEAU GRASSLANDS: IMPLICATIONS FOR POPULATION VIABILITY OF NATIVE PERENNIAL GRASSES

Primary investigator contact information:

Name: Dr. Tim Graham, USGS

Address: 2290 West Resource Blvd, Moab, UT 84532

Phone: 435 719-2339

Email: tim_graham@usgs.gov

Project Summary:

The change from native to non-native grasses affects quality, quantity and timing of available food for grasshoppers and other herbivores. Grasshopper community composition changes, and pressure on remaining native perennial grasses increases. Insectivores also respond

negatively to dominance by non-native grasses, primarily because of a simplification of plant architecture. Predation on grasshoppers and other herbivores thus decreases, resulting in additional consumption of remaining native species. It has been suggested that increased herbivory reduces competitive ability of native grasses enough that non-native species are able to maintain dominance even after the disturbances that allowed establishment have ceased.

The proposed study will document differences in grasshopper community structure in native and cheatgrass dominated grasslands of the Colorado Plateau, and correlate these differences with characteristics of the grassland vegetation communities such as amount of bare ground, grass height, cover of perennial and annual grasses, etc. Implications for interactions between cheatgrass and native perennial grasses will be explored as well. In particular, the effect of maturing cheatgrass on grasshopper survival and fecundity, and thus population size, will be tested, and experiments on competitive abilities of cheatgrass vs. selected native grasses with and without grasshopper herbivory will be conducted. The study could be expanded to the Great Basin and Columbia River Basin, which are also being overrun by cheatgrass and other introduced plants, to see if herbivory plays a role in continued dominance by these exotic species in other arid and semi-arid grasslands.

2005 Findings and Status:

No activity was conducted in Arches NP in 2005 related to this project.

9) Permit #: ARCH-2005-SCI-0009

Study Title:

VEGETATION DATA COLLECTION IN SUPPORT OF THE U.S. GEOLOGICAL SURVEY NATIONAL PARK SERVICE VEGETATION CLASSIFICATION AND MAPPING PROGRAM AT ARCHES NATIONAL PARK

Primary investigator contact information:

Name: Mr. James Von Loh, Engineering-Environmental Management, Inc.

Address: 9563 South Kingston Court, Suite 200, Englewood, CO 80112

Phone: 303-754-4216 **Email:** jvonloh@e2m.net

Project Summary:

The National Park Service (NPS) and U.S. Geological Survey (USGS) are cooperating to produce detailed vegetation classifications and digital databases, including vegetation maps, as part of the National Biological Information Infrastructure Program (NBII).

2005 Findings and Status:

While no field data collection was performed in ARCH in 2005, several other vegetation classification and mapping tasks were conducted. An illustrated field key of the 62 plant associations for ARCH was produced with photos and a dichotomous key. Photo interpretation created a vegetation map with a legend key that was digitized. Also, local descriptions of the 62 plant associations identified for ARCH were produced describing the environmental conditions and species present for the associations within the park.

10) Permit #: ARCH-2005-SCI-0010

Study Title:

SOIL SURVEY OF ARCHES NATIONAL PARK, UTAH

Primary investigator contact information:

Name: Mr Victor Parslow, USDA Natural Resources Conservation Service

Address: 340 North 600 East, Richfield, UT 84701.

Phone: 435.896.6441 ext. 134

Email: Vic.Parslow@ut.usda.gov

Project Summary:

Purpose of study: To provide an updated soil and ecological site inventory for Arches National Park (ARCH), that meets National Cooperative Soil Survey (NCSS) standards and park management and planning needs.

The existing soil survey was conducted in the late 1970's and the early 1980's as part of the Grand County, Utah soil survey. This inventory was primarily designed as a tool in managing grazing lands and has been found to be too general to be useful for managing the park. Information is lacking to model salt movement, mitigate visitor impacts, identify and protect habitat of Threatened and Endangered species, and other park responsibilities.

In 2003, representatives of the National Park Service approached the Natural Resources Conservation Service to update the soil survey within Arches and Canyonlands National Parks and Natural Bridges and Hovenweep National Monuments. The plan of work and contract were approved in 2004. This application is seeking permission to carry out the necessary field work to complete the contract.

2005 Findings and Status:

The Natural Resources Conservation Service (NRCS) began field work for providing an updated soil and ecological site inventory for Arches National Park in 2005.

1. Soil inventory activities

Pre-survey activities were conducted in Arches National Park in 2005, as well as data collection on soils and plants.

This included evaluation of the existing Soil Survey and Ecological Site Descriptions (ESD's). Relationships between the geology and associated soils were discussed, and theories on soil-geology-plant-landscape models were developed.

Field work in Arches National Park was initiated in 2005. Traverses of the landscape were conducted, and soil descriptions and plant inventory data recorded, in order to further develop the soil-plant-landscape-geology models.

2. Dynamic Soil Properties (DSP) Pilot and Study

In addition to traditional soil survey activities in Arches National Park, NRCS developed a pilot project in conjunction with the NRCS National Soil Survey Center and the Jornada Experimental Range-Agricultural Research Service (ARS), and the National Park Service. The objectives of this project are to summarize selected dynamic soil properties of the Begay soil for plant communities within various states of the Semidesert Sandy Loam (Fourwing Saltbush) ecological site; to determine if statistically or ecologically significant differences in the mean and variation of these soil properties exist between plant communities or states; to determine if any correlations exist between dynamic soil property values, plant community characteristics, and terrain characteristics; and to describe any relationships between the dynamic soil properties of the Begay soil and the plant community characteristics of different states of the Semidesert Sandy Loam (Fourwing Saltbush) ecological site.

This is a pilot study for developing new methodologies for collecting and interpreting data related to near-surface, dynamic soil properties, such as aggregate stability, compaction, organic matter, and other properties which may change depending on use and management. Although only one soil type (Begay) and one ecological site (Semidesert Sandy Loam) were selected for inclusion in this pilot, the information gathered will be used to determine how to integrate collection of dynamic soil data into traditional soil survey activities, thus adding value to the updated Soil Survey.

Some benefits to the managers of Arches National Park include:

1. Information about the correlation between dynamic soil properties, plant community characteristics (cover, production), and terrain characteristics.

2. Supporting data for the ecological site description including the rangeland health reference worksheet, the description of ecological dynamics, and a refined state and transition model.
3. A list of potential indicators (dynamic soil properties) for assessment and monitoring projects.
4. A report of point and summary data for dynamic soil properties and terrain characteristics under selected plant communities on the Begay soil. Data will be summarized by soil map unit component, elevation (low and high), and plant community (state).

Data was collected during the pilot study on randomly selected plots (20 m by 20 m) in Arches and Canyonlands National Parks. Soil descriptions and associated soil samples were collected from these plots, and sent to the National Soil Survey Laboratory in Lincoln, Nebraska for characterization. Data was collected in the field regarding soil aggregate stability, herbaceous and woody production, plot vegetation/erosion patterns, canopy and basal gap of the plant community, and other information which will be analyzed for correlations between dynamic soil properties and existing plant communities. The data, laboratory results, and any conclusions which may be drawn from this study will be made available to National Park personnel.

11) Permit #: ARCH-2005-SCI-0011

Study Title:

CARBON AND NITROGEN CYCLES IN ARID LANDS: THE ROLE OF BIOLOGICAL SOIL CRUSTS AS INFLUENCED BY SOIL SURFACE DISTURBANCE, CLIMATE CHANGE AND ANNUAL GRASS INVASION

Primary investigator contact information:

Name: Dr Jayne Belnap, USGS Canyonlands Field Station

Address: 2290 SW Resource Blvd., Moab, UT 84532

Phone: 435-719-2333

Email: jayne_belnap@usgs.gov

Project Summary:

This project will establish how alterations in species composition by surface disturbance, invasive grasses, and/or climate change may affect N and C inputs and fluxes, in different soils under different climatic regimes.

2005 Findings and Status:

STRUCTURE AND FUNCTION OF SOIL BACTERIAL AND FAUNAL COMMUNITIES AROUND A GRASS AND SHRUB AS INFLUENCED BY BIOLOGICAL SOIL CRUSTS . Vascular plants and soil crusts provide resources directly to soil bacteria and faunal grazers, and indirectly to other soil fauna that feed on them. Plants and soil crusts may also shape the structure and function of soil communities by controlling inputs of carbon, nitrogen, water and light into the soil. Because soil resource availability is expected to decline with decreased plant and crust cover, and differ by plant and crust type, we examined two plant and crust types to quantify underlying soil chemistry and bacterial and faunal communities. In two separate locations, containing both early successional (*Microcoleus* dominant) and later successional (*Nostoc/Scytonema/Collema*) soil crusts, we sampled three microsites (stem, dripline, and interspace) around a dominant shrub (*Coleogyne ramosissima*) and grass (*Stipa hymenoides*). Soil chemistry analyses revealed N availability typically was greater at the plant stem, while P availability was greater in interspaces around *Coleogyne*. Microsites closer to the plant had greater abundance of rhizosphere-dependent bacteria and nematodes, regardless of crust type. Soil protists, however, rarely differed by microsite in either crust type, indicating that soil crusts may more strongly influence their distribution than vascular plants. Abundance of soil biota also differed by plant species, with *Coleogyne* supporting more bacteria and fauna than *Stipa*. Overall, these results support the hypothesis that plants and biological soil crusts affect the structure and function of soil bacterial and faunal communities. Global change induced shifts in plant community composition or losses of biological soil crusts in the southwestern US will likely result in reduced soil nutrient cycling via declines in plants, biological soil crusts, and their dependent organisms.

12) Permit #: ARCH-2005-SCI-0012

Study Title:**NORTHERN AND SOUTHERN COLORADO PLATEAU NPS SPRINGS ECOSYSTEMS
INVENTORY****Primary investigator contact information:****Name:** Dr. Abraham Springer, Northern Arizona University**Address:** P.O. Box 4099, Flagstaff, AZ 86011**Phone:** 928.523.7198**Email:** abe.springer@NAU.EDU**Project Summary:**

As part of the joint Northern and Southern Colorado Plateau Parks Networks collaboration on springs ecosystems, we are conducting a comprehensive physical and biological inventory of springs ecosystems on NPS units on the Colorado Plateau. This project will be conducted by staff from Northern Arizona University, Flagstaff, Arizona with funds from the National Park Service (Cooperative Agreement Number: CA 1200-99-009, attached below). We would like to conduct an inventory of several springs on your NPS unit to test our methods and provide you with information on the ecological condition of your springs.

This inventory will be conducted by Abraham Springer and Lawrence Stevens of the Geology Department at Northern Arizona University, and their assistants. These two researchers recently produced a springs ecosystem conceptual model, a comprehensive springs classification system, and a suite of springs inventory protocols that we are testing for further use in assessing the health of springs ecosystems. Their curriculum vitae are available upon request.

These inventories will require approximately one half day / site, and will involve mapping the site and its vegetation, and collecting water, soil, and biological specimens (especially plants and invertebrates). We have extensive experience inventorying springs ecosystems on National Park lands in Grand Canyon, Lake Mead National Recreation Area, Glen Canyon National Recreation Area, and other NPS lands. Through this experience, we have learned how to minimize researcher impacts on these delicate ecosystems, and we will use that knowledge to make sure we minimize our impacts to the sites visited.

The study sites will include those that best represent the variety of springs habitats on your NPS land unit. Selection criteria include diverse settings, elevations, and water chemistries, and the sites inventories will hopefully include both pristine and human altered sites. Your staff may have recently provided a list of candidate springs for this analysis, and we will follow up on that site selection by personally contacting the appropriate staff to better understand the timing and access to the sites. We are providing a comprehensive list of study sites in this permit application, which will be refined once we discuss priority and access with appropriate NPS staff and confirm the collection dates. The data collected will be incorporated into a newly created comprehensive NPS database and the researcher's classification system. Data will be provided back to your NPS unit for your information and use.

The draft protocols to be used during the springs inventories are attached. The Northern and Southern Colorado Plateau networks are jointly developing a database into which the data will be compiled. Specimens collected through this project will be sacrificed for analysis (e.g., water quality samples), or prepared and housed at the Museum of Northern Arizona in Flagstaff, an approved NPS repository.

2005 Findings and Status:

During 2005, 75 springs were inventoried in 26 units of the National Park Service for the Northern and Southern Colorado Plateau Inventory and Monitoring Network. The inventories included site descriptions, environmental and climate conditions, vegetation and invertebrate surveys, wildlife observations, water-quality analyses, geomorphology descriptions, and water-quantity measurements. We inventoried Poison Ivy Spring and Willow springs at Arches National Monument. A final project report to be submitted to the I&M Network in spring 2006 will include a summary of the inventories of these springs.

13) Permit #: ARCH-2005-SCI-0013

Study Title:

**INTERPRETING 250M MODERATE RESOLUTION IMAGING SPECTRORADIOMETER
NORMALIZED DIFFERENCE VEGETATION INDEX IN THE COLORADO PLATEAU**

Primary investigator contact information:

Name: Dr. Michael White, Utah State University
Address: 5210 Old Main Hill, AWER, Logan, UT 84322-5210
Phone: 435.797.3794 **Email:** mikew@cc.usu.edu

Project Summary:

The National Park Service (NPS) Southern and Northern Colorado Plateau Networks (SCPN and NCPN) intend to implement remotely sensed programs to monitor long-term ecosystem status and to detect the occurrence of abnormal ecosystem states and/or processes. A key element of this work will be use of the 250m resolution data from the moderate resolution imaging spectroradiometer (MODIS). These data include the normalized difference vegetation index (NDVI), red (620-670 nm), and near infrared (NIR, 841-876 nm) bands. For the purposes of this scope of work, the term MODIS data refers to the combined suite of NDVI and red and near infrared bands.

Prior to implementing these data in any management context, the NPS requires a clear understanding of the relationship between NDVI data and ground conditions at specific parks. While NDVI is known to be related to the fraction of photosynthetically active radiation absorbed by plant canopies (FPAR), leaf area index (LAI), and green fractional cover (GFC), it is also strongly influenced by soil conditions, canopy geometry, and the presence of senescent vegetation. Thus, across a spectrum of NPS units, it is probable that the same NDVI value could represent different ground conditions. These uncertainties are especially important for the SCPN and NCPN, in which semi-arid conditions dominate and vegetation fractional cover tends to be low.

The goal of the proposed work is therefore to conduct a proof-of-concept field campaign in which intensively measured ground conditions will be compared with MODIS data. The comparison will be conducted in the following ecosystems: (1) grass, (2) mixed shrub/grass, and (3) woodland (consisting of a mixed pinyon-juniper overstory with possible understory grass and shrubs).

Specific objectives of this effort are:

- Using ground-based measures, characterize with- and among-season trends in vegetation condition of grasslands, shrublands, and woodlands. Ground-based measures will include Plant Area Index (PAI, similar to LAI but includes stem material) and GFC.
- Determine which scales are appropriate for use of MODIS data by investigating correlations of ground measures with MODIS data at multiple spatial scales (1 MODIS pixel, 2 x 2 pixels, 3 x 3 pixels).

To accomplish these objectives, the project will consist of five main tasks:

1. Site selection.
2. Sampling design and logistics.
3. Field measurements.
4. Remote sensing.
5. Analysis.



14) Permit #: ARCH-2005-SCI-0014

Study Title:

BIOLOGY AND DISTRIBUTION OF THE BUTTERFLIES OF ARCHES NATIONAL PARK

Primary investigator contact information:

Name: Clyde Gillette, Utah Lepidoptera Society

Address: 3419 El Serrito Dr., Salt Lake City, UT 84109

Phone: 801.484.5804

Email: cfg_utah_bfs@networld.com

Project Summary:

To create an Expanded Checklist of the Butterflies of Arches and Canyonlands National Parks which will include distribution in space and time, documented larval foodplants, limited developmental histories, and some behavioral traits. (Some information on plants will be included, but only as required to emphasize the butterflies' story. I know the bfs' plants fairly well, so the collection of plants will be extremely limited.)

2005 Findings:

No field work was performed in 2005.

15) Permit #: ARCH-2005-SCI-0015

Study Title:

FIELD-BASED EVALUATIONS OF MEASURES AND MEASUREMENT TECHNIQUES TO SUPPORT LONG-TERM MONITORING OF TERRESTRIAL ECOSYSTEMS IN COLORADO PLATEAU NATIONAL PARK SERVICE UNITS

Primary investigator contact information:

Name: Dr. Mark Miller, U. S. Geological Survey

Address: 2290 SW Resource Blvd., Moab, UT 84532

Phone: 435-719-2340

Email: mark_miller@usgs.gov

Project Summary:

This project involves field-based evaluations of a limited suite of measures and measurement techniques for long-term monitoring of terrestrial ecosystems characteristic of the Colorado Plateau region. The project is designed to support the Northern and Southern Colorado Plateau Networks (NCPN and SCPN, respectively) of the National Park Service's Inventory and Monitoring Program (NPS I&M Program). In conjunction with the I&M Program, ecoregional networks of NPS units have been charged with the task of identifying "vital signs" to be monitored for the purpose of tracking long-term trends in the "health" or condition of park ecosystems. Collectively, the NCPN and SCPN have identified an integrated suite of vital signs for tracking resource conditions in 35 NPS units located in the Colorado Plateau region of Utah, Arizona, Colorado, and New Mexico. To inform the selection of monitoring methods most suited to NPS monitoring objectives for these parks, the NCPN and SCPN have a need for field-based evaluations of measures and measurement techniques across the range of ecosystems likely to be monitored. In addition, the NCPN and SCPN require detailed standard operating procedures (SOPs) for methods selected for implementation.

Following are general objectives for this project.

1. Collect and analyze field data to evaluate a limited suite of measures and measurement techniques for their relative suitability in effectively and efficiently meeting NPS monitoring needs across the range of ecosystems likely to be monitored.
2. Characterize within- and among-site variability in monitoring measures to inform NPS planning for operational monitoring.
3. On the basis of site soil, landscape, and vegetation characteristics, evaluate the accuracy of stratification data used to select field sites for sampling.
4. Following USGS-NPS guidelines (Oakley et al. 2003), prepare SOPs for methods selected for implementation.

2005 Findings and Status:

During the 2005 field season, we sampled 48 1-ha macroplots located in seven Colorado Plateau NPS units, including five macroplots in Arches National Park. Sampling was designed to (1) evaluate different methods for sampling vegetation and soil attributes and (2) document within- and among-macroplot variability in sampling measures to inform decisions about monitoring design. In the blackbrush-dominated macroplots sampled in Arches National Park, we found that vegetation sampling by the line-point-intercept method generally was more efficient (in terms of the amount of time required for a given level of precision) than sampling with 10-m² quadrats or 1-m² quadrats. All cover measures were more variable within macroplots than among macroplots. All three methods were found to yield results which were repeatable by different observers. Sampling with 10-m² quadrats greatly increased the detection of rare plant species, but this method also tended to result in a large degree of soil disturbance due to trampling.

A full report describing these results in greater detail will be provided to the NPS Inventory and Monitoring Program.

16) Permit #: ARCH-2005-SCI-0016

INVESTIGATION OF PALEOFLOOD DEPOSITS OF THE COLORADO RIVER ABOVE THE MOAB URANIUM MILL SITE

Primary investigator contact information:

Name: Dr. Noam Greenbaum, University of Arizona

Address: c/o Dr. Victor Baker, Lunar and Planetary Lab, University of Arizona, Gould-Simpson 352, Tucson, AZ 85721

Phone: 520-626-9788 **Email:** noam@hwr.arizona.edu

Project Summary:

Paleoflood deposits have been observed on the Arches National Park side of the Colorado River, opposite of the boat launch at Milepost 10.3, Highway 128. We propose to collect samples and map these deposits to determine the volume of a probable maximum flood on the Colorado River. This information will be provided to the agencies which manage the water resources of the Colorado River.

17) Permit #: ARCH-2005-SCI-0017

Study Title:

VERTEBRATE SPECIES IN UTAH NATIONAL PARKS

Primary investigator contact information:

Name: Mr George Oliver, Utah Natural Heritage Program

Address: Utah Division of Wildlife Resources, 1594 W. North Temple, Salt Lake City,

UT 84116-3154

Phone: 801-538-4820

Email: georgeoliver@utah.gov

Project Summary:

The principal purpose of this research is to increase basic knowledge and understanding of biological inventories with specific vertebrate species verification. This is one component of the biological inventories being conducted within the units of the NCPN as part of a national emphasis on inventory and monitoring within the National Park Service. Species verification will benefit the NPS and UDWR and the entire scientific community through updated information housed in the Automated National Catalog System (ANCS+), the NPS national biodiversity database, NPSpecies, and the UDWR state biodiversity database.

The purpose of the biological inventories is to document 90 percent of the vascular plant and vertebrate animal species in the units of the NCPN. Data collected from these inventories are incorporated into the national bio-diversity database, NPSpecies. In order to verify the existence of a species in a park unit, the NCPN requires a voucher specimen, a photograph, or an authoritative observation for each species listed in the database.

Species verification may be obtained from a number of sources such as NCPN inventories; existing voucher data housed in the ANCS+; from data mining efforts at other museums and herbaria; and from review of technical reports and publications. The taxonomic nomenclature associated with these verification sources is often outdated or incorrect; for example, museums may mistakenly list a particular species as collected from a Utah park, leaving the verification process in question. Once all sources have been reviewed, there are often gaps remaining in the species verification process which need to be filled.

The NPS and UDWR agree to work cooperatively toward obtaining voucher, photographic or observational data for the herpetofauna, mammalian, and avian species currently lacking complete information, and to standardize the taxonomic nomenclature for all species in the Utah units of the NCPN.

2005 Findings and Status:

No activity was conducted this report year.

18) Permit #: ARCH-2005-SCI-0018

Study Title:

FACTORS INFLUENCING DISTRIBUTION & MORTALITY OF A DOMINANT RIPARIAN TREE

Primary investigator contact information:

Name: Alicyn Gitlin, Northern Arizona University

Address: 2135 S. Ash Lane, Flagstaff, AZ 86004

Phone: 928.523.5970

Email: arg24@dana.ucc.nau.edu

Project Summary:

This project is investigating drought-related mortality in cottonwood trees (*Populus* sp.). Research begun in 2003 & 2004 yielded 2 major findings: 1) the presence of the invasive species tamarisk (*Tamarix* sp.) is correlated with increased levels of cottonwood mortality, and 2) the first generation hybrid of Fremont cottonwood (*P. fremontii*) and narrowleaf cottonwood (*P. angustifolia*) is experiencing less mortality than its parent species. We believe that tamarisk is acting as an agent of selection during this drought, removing all but the most salinity- and drought-tolerant tree genotypes. We also predict that hybrid trees will survive prolonged drought conditions more successfully than narrowleaf or Fremont cottonwood.

In order to determine whether the removal of tamarisk from a site improves conditions for cottonwood survival and growth, areas of tamarisk infestation and restoration areas where tamarisk has been removed will be compared. Branch growth, stand mortality, and soil salinity will be measured at restored and non-restored sites. This will require the collection of soil samples and may require some branch clipping, but we will try to minimize cuttings and will agree to not cut branches at the park's request.

The outcome of these studies will be a greater understanding of the benefits of riparian restoration and the ways that soils affect the distribution of cottonwood trees.

19) Permit #: ARCH-2005-SCI-0019

Study Title:

PALAEOENVIRONMENTAL SETTING OF TETRAPOD TRACKS IN THE CEDAR MOUNTAIN FORMATION, ARCHES NATIONAL PARK

Primary investigator contact information:

Name: Dr. Joanna Wright, University of Colorado at Denver

Address: Department of Geography & Environmental Sciences, Campus Box 172, PO Box 173364
Denver, CO 80217

Phone: 303-556-6007 **Email:** joanna.wright@cudenver.edu

Project Summary:

To examine the mode of preservation and environmental setting of terrestrial tetrapod trace fossils in the Cedar Mountain Formation of Arches National Park with a view to assessing the diversity and paleoecology of the trace fossil assemblage in comparison to other track assemblages of similar age in the western United States and elsewhere. Preliminary reports (Lockley et al 2004) has indicated that the assemblage may be unusually diverse but detailed prospecting for tracks and analysis of track-bearing layers within the section has not yet been carried out (Kirkland pers.comm.).

This project seeks to rectify this situation with the production of a detailed stratigraphic section and more extensive prospecting for tracks in the Cedar Mountain Formation.

Collections:

No specimens will be collected for this project. This is a survey only.

20) Permit #: ARCH-2005-SCI-0020

Study Title:

Determining the effect of tamarisk invasion on stream invertebrate communities on the Colorado Plateau

Primary investigator contact information:

Name: Angie Moline, COLORADO STATE UNIVERSITY

Address: Department of Biology, E330 Anatomy-Zoology Bldg., Fort Collins, CO 80523

Phone: 970.491.2329 **Email:** amoline@lamar.colostate.edu

Project Summary:

The rate of exotic species invasion in North America has drastically increased since European settlement. Non-native invasion is one of the most important causes of species endangerment in the US and is a major component of anthropogenic global change. In the western US, native cottonwood-willow floodplain forests are being replaced by exotic species such as tamarisk (*Tamarix* sp.) and Russian olive (*Elaeagnus angustifolia*). Riparian vegetation occurs on <1% of the western North America landscape, yet it provides habitat for more species of birds than all other vegetation types combined. Riparian vegetation influences stream communities by shading, contributing leaf litter, and stabilizing the stream banks. Stream nutrients are transferred to riparian ecosystems when terrestrial predators, such as riparian birds and lizards, consume emergent aquatic mayflies, such as mayflies.

The effect of tamarisk and Russian olive invasion on stream-riparian ecosystems is poorly understood, but could be dramatic as tamarisk alone dominates over 600,000 riparian and wetland hectares. These exotics are probably changing stream geomorphology and hydrology, modifying aquatic insect communities, and threatening native bird populations. These problems are particularly pressing in the arid west where water managers attempt to meet the ever increasing needs of society and maintain habitat for federally threatened and endangered aquatic life.

Macroinvertebrates are commonly used as ecological indicators in streams for three reasons. 1) They are an important link in stream-riparian food webs. Invertebrates form a critical link between primary producers and consumers because they are able to utilize a variety of food sources, such as algae, detritus, wood, and invertebrate prey. 2) Different taxa tolerate different levels of habitat and water quality degradation. 3) They are relatively easy to collect and identify.

The purpose of my research is to develop an understanding of how stream invertebrate communities are altered by invasive riparian vegetation and to determine the mechanisms behind these changes. I will look at the effect of tamarisk invasion on western stream-riparian ecosystems through comparative natural experiments, field experiments, and lab experiments. This research will increase our understanding of how riparian vegetation structures stream invertebrate communities and will yield useful information on the community- and ecosystem-level effects of non-native vegetation.

Under this permit, I would like to conduct a natural experiment to determine the changes that occur in aquatic invertebrate communities when tamarisk invades a stream-riparian ecosystem. I will examine 20 sites on the Colorado Plateau on streams with varying degrees of tamarisk infestation. Sites will be chosen that have approximately 0%, 25%, 50%, 75%, and 100% tamarisk cover with the remainder of the riparian forest consisting of native trees. Abiotic conditions will be characterized and aquatic invertebrates, algae, and leaf packs will be collected from each site. Leaf pack samples will be used to determine aquatic macroinvertebrate colonization of leaf material and to assess which types of leaves are being retained in leaf packs in the stream. Multivariate statistics (MANOVA) will be used to determine whether invertebrate community parameters (e.g. invertebrate diversity, biomass) are related to riparian vegetation type.

This will be the first broad scale study to look at the effects of non-native vegetation on stream invertebrates in the U.S. In other parts of the world (e.g., Portugal, Spain, Australia) studies of invertebrate assemblages in streams draining native and exotic forests have found differences in abundance, richness, and taxonomic composition. In general, these studies found more diverse and abundant insect communities at sites dominated by native rather than exotic vegetation.

Collections:

At each site, I will collect benthic invertebrates, leaf packs, and algae in order to determine the algal abundance and invertebrate community structure in streams flowing through native and exotic riparian forest. Each site will be visited only once, in autumn after leaf packs have formed in streams. Five invertebrate samples will be collected at each site with a Hess sampler. Ten leaf packs, and associated invertebrates, will be collected from the stream. Five algal samples will be collected by scraping algae from a 10x10 cm patch from five cobbles. At a subset of sites (approximately half) I will collect additional algae, stream detritus, leaf pack, aquatic invertebrate and riparian leaf samples for stable isotope analysis. At these sites I will collect three additional Hess samples, three additional leaf pack samples, and three additional algae samples. I will also collect 20 g of leaves from each of the dominant riparian trees and 500 ml of water and stream detritus

Invertebrate species data will reside in the C. P. Gillette Museum of Arthropod Biodiversity at Colorado State University in Fort Collins, CO. The data will also be published in my dissertation and therefore archived at the Colorado State University Library.

2005 Findings and Status:

We collected benthic invertebrates from Salt Wash and Courthouse Wash in Arches NP. These invertebrate samples are still being processed. A final report will be submitted next year.

